

AD

AD 665358

VL-2488-3-O

DEVELOPMENT OF ELECTROPHORETIC PROCESS FOR
COATING T-53 AIR DIFFUSER, EXHAUST DIFFUSER, AND
COMBUSTION CHAMBER HOUSING WITH "SERMETEL W"®

PHASE III TECHNICAL REPORT

K. A. Gebler

7 November 1967 - 21 January 1968

Prepared for

Headquarters, U. S. Army Aviation Materiel Command
St. Louis, Missouri 63166

By

Vitro Laboratories
West Orange, New Jersey 07052

Prepared Under

Contract No. DAAJ01-67-C-2207(G)

Vitro Job No. 2488

Distribution of this Document is Unlimited

Vitro

LABORATORIES

DIVISION OF VITRO CORPORATION OF AMERICA

200 Pleasant Valley Way, West Orange, N. J.

Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va 22151

DDC
RECEIVED
FEB 23 1968
B

22

NOTICES

DISCLAIMERS

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The citation of trade names and names of manufacturers in this report is not to be construed as official Government endorsement or approval of commercial products or services referenced herein.

DISPOSITION

Destroy this report when it is no longer needed. Do not return it to the originator.

ACCESSION NO.	
SPOT	WRITE SECTION <input checked="" type="checkbox"/>
DOC	DIFF SECTION <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
SUBMIT TO AVALANCHE	
QEL	Attn: [illegible]
1	

AD

VL-2488-3-O

DEVELOPMENT OF ELECTROPHORETIC PROCESS FOR
COATING T-53 AIR DIFFUSER, EXHAUST DIFFUSER, AND
COMBUSTION CHAMBER HOUSING WITH "SERMETEL W"®

PHASE III TECHNICAL REPORT

K. A. Gebler

7 November 1967 - 21 January 1968

Prepared for

Headquarters, U. S. Army Aviation Materiel Command
St. Louis, Missouri 63166

By

Vitro Laboratories
West Orange, New Jersey 07052

Prepared Under

Contract No. DAAJ01-67-C-2207(G)

Vitro Job No. 2488

Distribution of this Document is Unlimited

***Vitro* LABORATORIES** DIVISION OF VITRO CORPORATION OF AMERICA
WEST ORANGE LABORATORY • 200 Pleasant Valley Way, West Orange, N. J.

ABSTRACT

This report covers activities accomplished during Phase III of a ten (10) month program to develop an electrophoretic coating method for the application of "SERMETEL[®] W"^{*} to all critical surfaces of the exhaust diffuser, air diffuser and combustion chamber housing of the T-53 engine. "SERMETEL W" has been classified by various engine manufacturers and DOD agencies as the best coating available for corrosion protection.

During this phase a support fixture for loading, unloading and holding parts during coating was designed, fabricated and installed. A 200 VDC, 50 ampere power supply was checked out in coating experiments on combustion chamber segments and found to be in good working order. Full-scale electrode assemblies were completed for the air and exhaust diffuser components. Satisfactory humidification of coated panels and segments was obtained at 136°F and relative humidities of 61 and 66%. Metallurgical studies of combustion chamber housing segments indicated coatings of good uniformity and salt spray corrosion resistance.

^{*}Registered Trademark, Product of Teleflex, Inc., North Wales, Pa.

FOREWORD

This Phase III Technical Report covers work performed under Contract No. DAAJ01-67-C-2207(G) during the period 7 November 1967 - 21 January 1968.

This program is being conducted by the Chemistry and Arc Materials Department, West Orange Laboratory, Vitro Laboratories Division. The program is under the technical direction of F. E. Stevens, Directorate of Research, Development and Engineering, AVCOM, St. Louis, Missouri 63116.

Kenneth A. Gebler is the Vitro Project Leader. No other major contributions were made to this report by other persons.

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT	i
FOREWORD	ii
OBJECTIVES	1
PROGRAM PLAN	5
EXPERIMENTAL PROGRESS	6
FUTURE WORK	14
DISTRIBUTION LIST	15

LIST OF ILLUSTRATIONS

Figure

1	Exhaust Diffuser for T-53 Engine P/N 1-150-110-01	2
2	Air Diffuser for T-53 Engine P/N 1-110-230-01	3
3	Combustion Chamber Housing for T-53 Engine P/N 1-130-020-05	4
4	Support Fixture	7
5	Full Size Electrode Assembly for Combustion Chamber Housing	8
6	Full Size Electrode Assembly for Air Diffuser	9
7	Full Size Electrode Assembly for Exhaust Diffuser	10
8	Cross-Section Photomicrograph of SERMETEL W Coated Combustion Chamber Housing Sections	12
9	Test Specimens After 60 Hour Exposure to Salt Fog	13

OBJECTIVES

The developmental effort under this program has two major objectives. The first is to develop the process methods and equipments to electrophoretically coat "SERMETEL W" on all critical surfaces of three T-53 engine components. These components, the exhaust diffuser, air diffuser, and combustion chamber housing are shown in Figures 1, 2, and 3, respectively.

The second objective, after successful coating procedures and equipment have been developed, is to coat a minimum of two parts of each type and deliver these parts to a site selected by the Contracting Officer for evaluation and qualification of the coating.

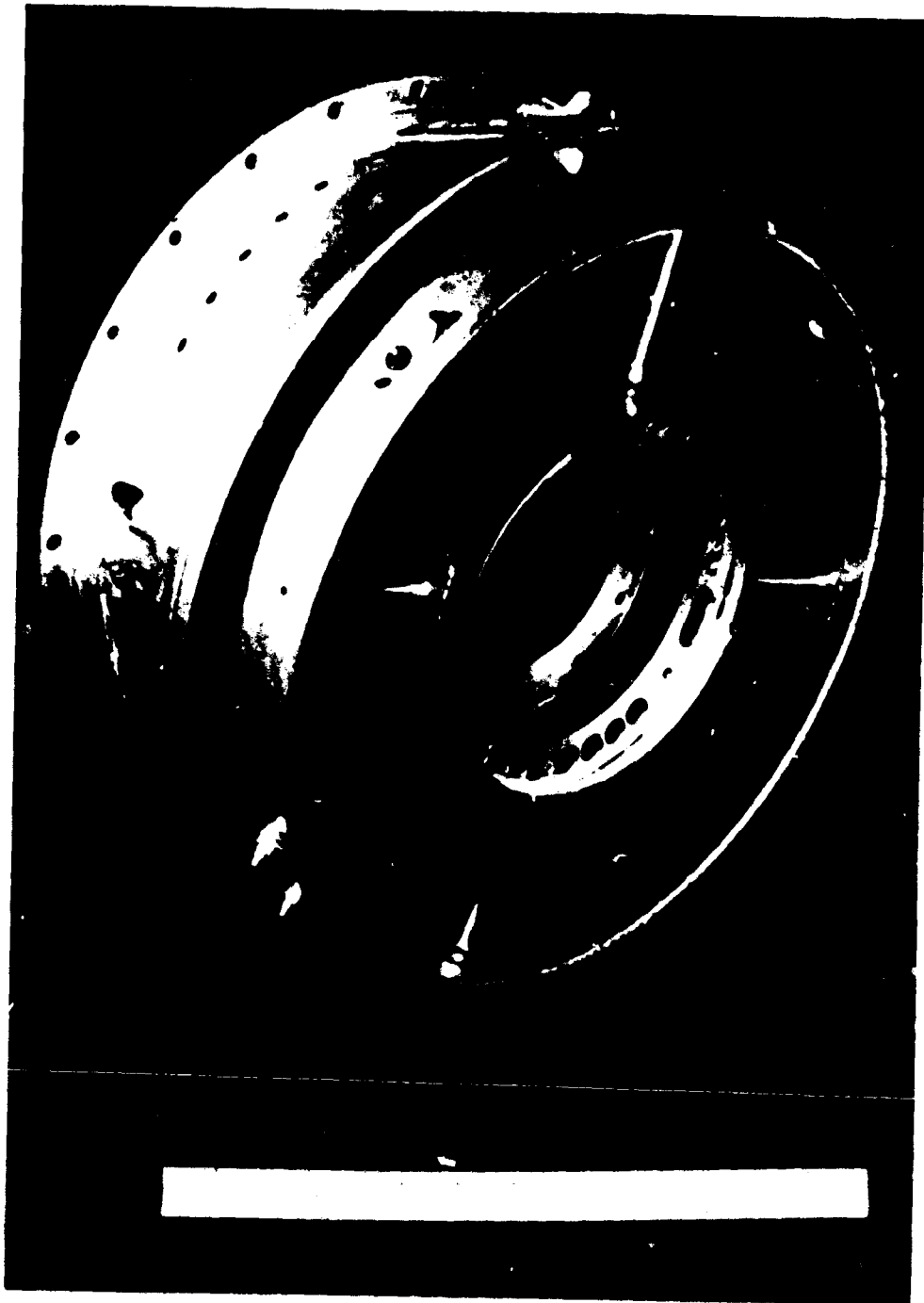


FIGURE 1

EXHAUST DIFFUSER FOR T-53 ENGINE
P/N 1-150-110-01

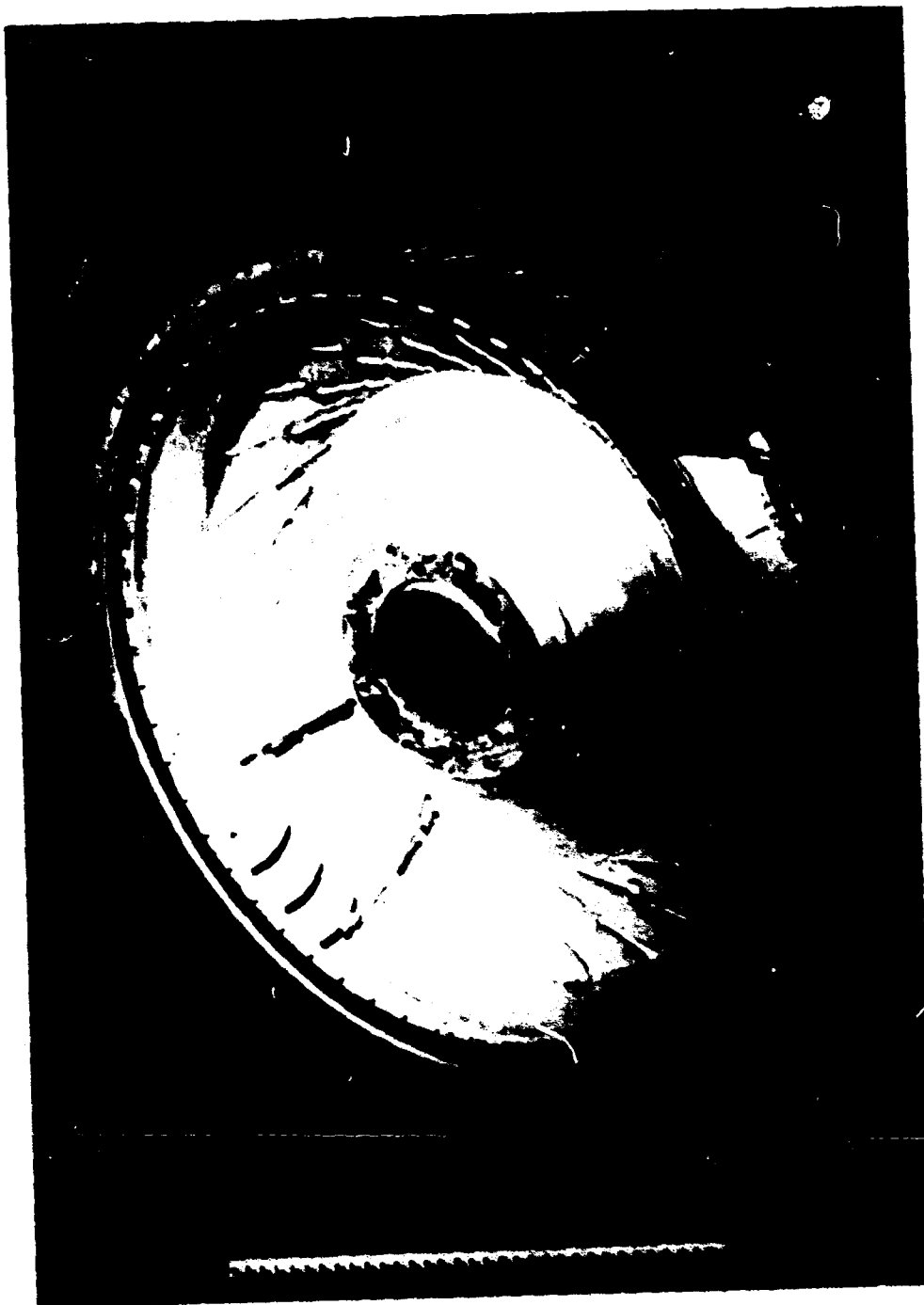


FIGURE 2

AIR DIFFUSER FOR T-53 ENGINE
P/N 1-110-230-01



FIGURE 3

COMBUSTION CHAMBER HOUSING FOR T-53 ENGINE
P/N 1-130-020-05

PROGRAM PLAN

The developmental effort has been divided into five essential phases:

- I. Design and Installation of Coating Equipment
- II. Dummy Coating Runs and Refinement of Electrode Design
- III. Heat Treatment and Evaluation of Coated Components
- IV. Full Scale Coating Trials
- V. Delivery of Final Specimens

Through necessity, the work in each of the five phases will overlap and efforts will, therefore, be concurrent in one or more phases as the program progresses.

EXPERIMENTAL PROGRESS

Phase I - Design and Installation of Coating Equipment

A. Support Fixture

During this period a support fixture for holding the parts during coating was designed, fabricated and installed. It consists of two L-shaped steel arms which can be made to move in an arc by means of a set of gears and turning handle. Photographs of the support fixture with a combustion chamber housing and anode in two positions, loading or unloading and over the coating tank are shown in Figure 4.

B. Power Supply

The 200 VDC, 50 ampere power supply was checked out in November and used for power in coating several segments cut from a combustion chamber housing. It was determined from trial runs that a timing device and a 200 ohm, 250 watt resistor would be necessary for efficient and safe operation. These devices are in process of being installed.

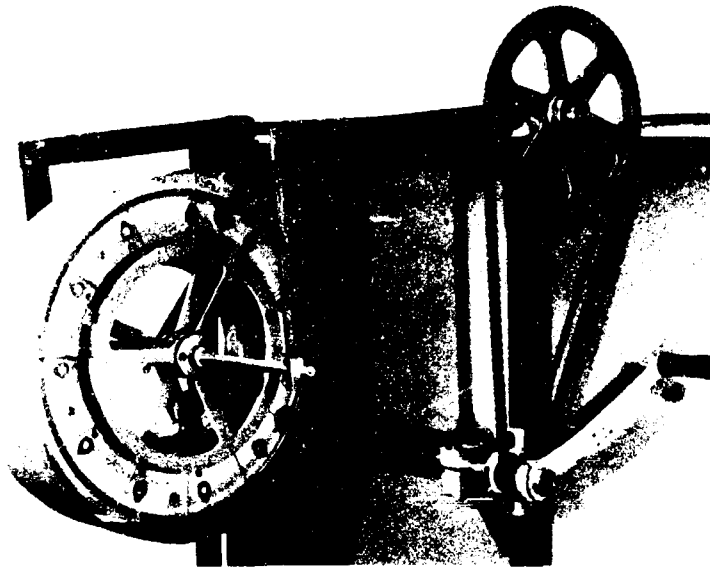
Phase II - Dummy Coating Runs and Refinement of Electrode Design

The first trial electrode assemblies for the full size air and exhaust diffusers were completed during this period. Several views of each are shown in the photographs of Figures 6 and 7. For comparison, the full size electrode assembly for the combustion chamber housing reported in the last progress report is shown in Figure 5.

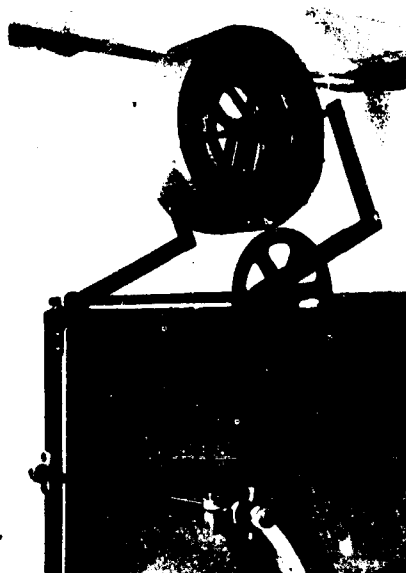
Phase III - Heat Treating and Evaluation of Components

A. Humidification Studies

Coated trial panels as well as segments cut from parts were humidified after coating in a chamber with a 136°F dry bulb temperature and a relative humidity of 61%. In general, it was necessary to treat the parts under these conditions for 16 hours in order to dissolve the dry binder material in the coating and to improve the smoothness of the coating surface. Humidification studies were also made with the chamber at 136°F dry bulb temperature and a relative humidity of 66%. Under these conditions satisfactory humidification



Loading or Unloading Position



Position Prior To Immersion

FIGURE 4

SUPPORT FIXTURE

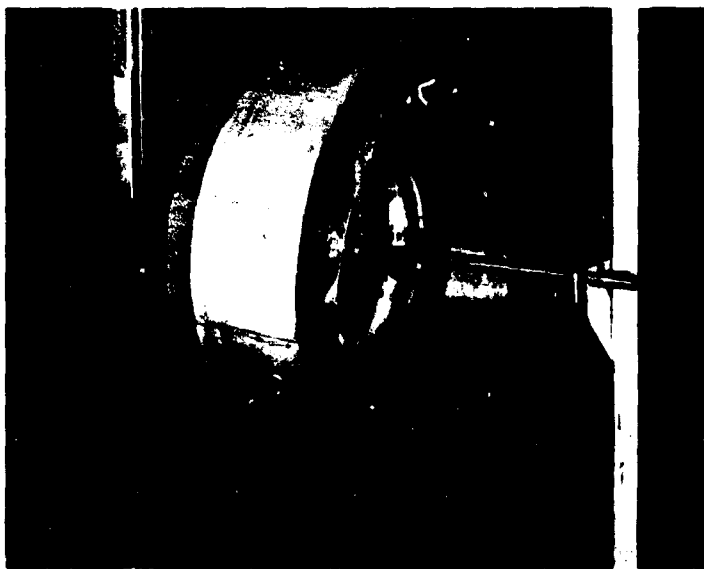


FIGURE 5

FULL SIZE ELECTRODE ASSEMBLY
FOR COMBUSTION CHAMBER HOUSING

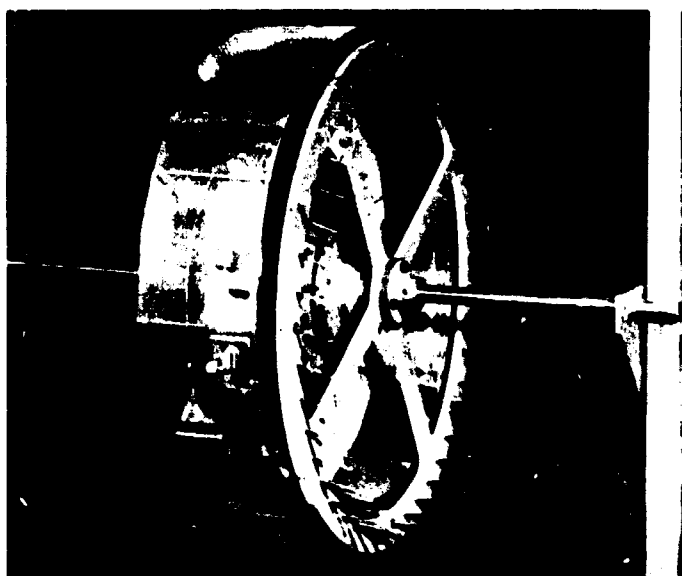
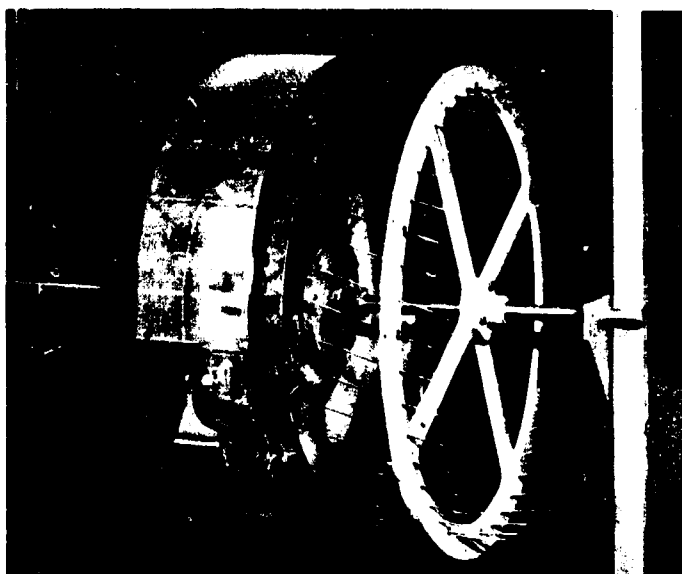


FIGURE 6

FULL SIZE ELECTRODE ASSEMBLY
FOR AIR DIFFUSER

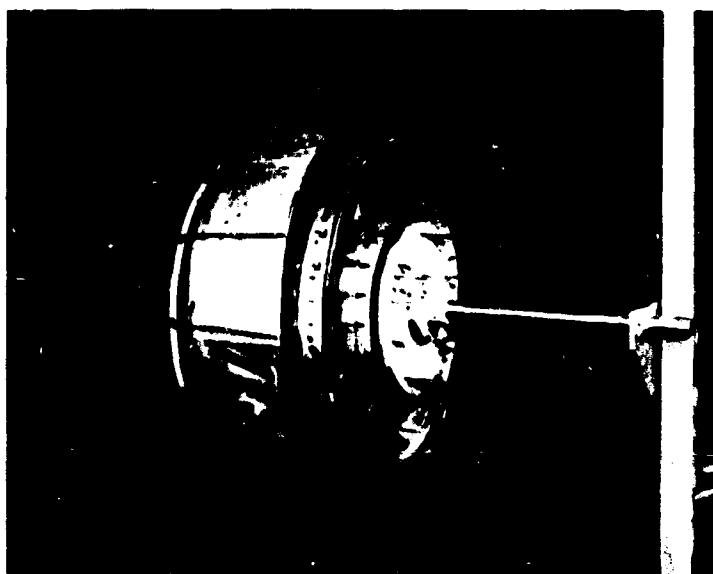


FIGURE 7

FULL SIZE ELECTRODE ASSEMBLY
FOR EXHAUST DIFFUSER

of the coatings was obtained in as little as 2-1/2 to 3 hours. Other tests with the relative humidity at 71% caused excess moisture to be formed on the surfaces of specimens. Undesirable dripping and running of the wet binder occurred.

B. Metallographic Studies

Studies were made during this period of the structure and uniformity of the electrophoretically deposited SERMETEL W coating. For these studies the specimens were taken from the side wall of the combustion chamber housing segments which had been processed and then tested for 48 and 60 hours in a 5% NaCl spray corrosion chamber at 120°F. Excellent performance of the coating in protecting the steel substrate from the corrosive and rusting effects of the warm salt water-vapor atmosphere was obtained. The photomicrographs, Figure 8, show the typical structure of these electrophoretic SERMETEL W coatings. Good uniformity is evident. A recessed metal-to-metal joint cross section is also shown in Figure 8 to illustrate what may be a more difficult area in the efforts to obtain complete coating coverage on these complex engine components.

C. Corrosion Tests

Both uncoated and coated segments of a combustion chamber housing were exposed for a nominal test of 60 hours in the salt fog test apparatus to determine the effect of the warm salt vapor on the parts. The pieces, after testing, are shown in Figure 9. It can be seen that the uncoated steel has oxidized badly over most of the surfaces. The coated part withstood the effects of the corrosive atmosphere quite well. Oxidation can be found in seam and joint areas but this is minimal, and it is expected that these areas can be improved in future coating trials.

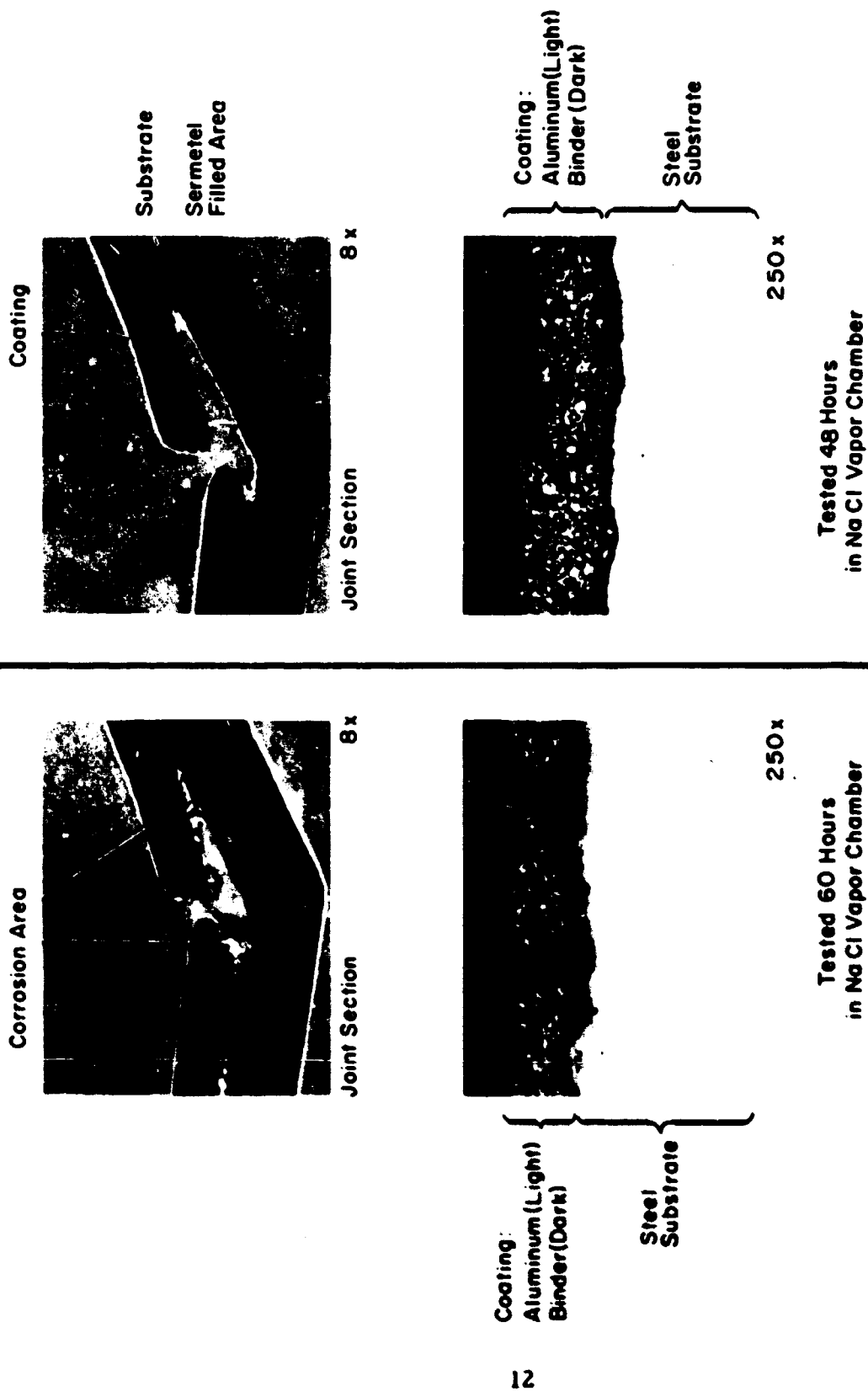
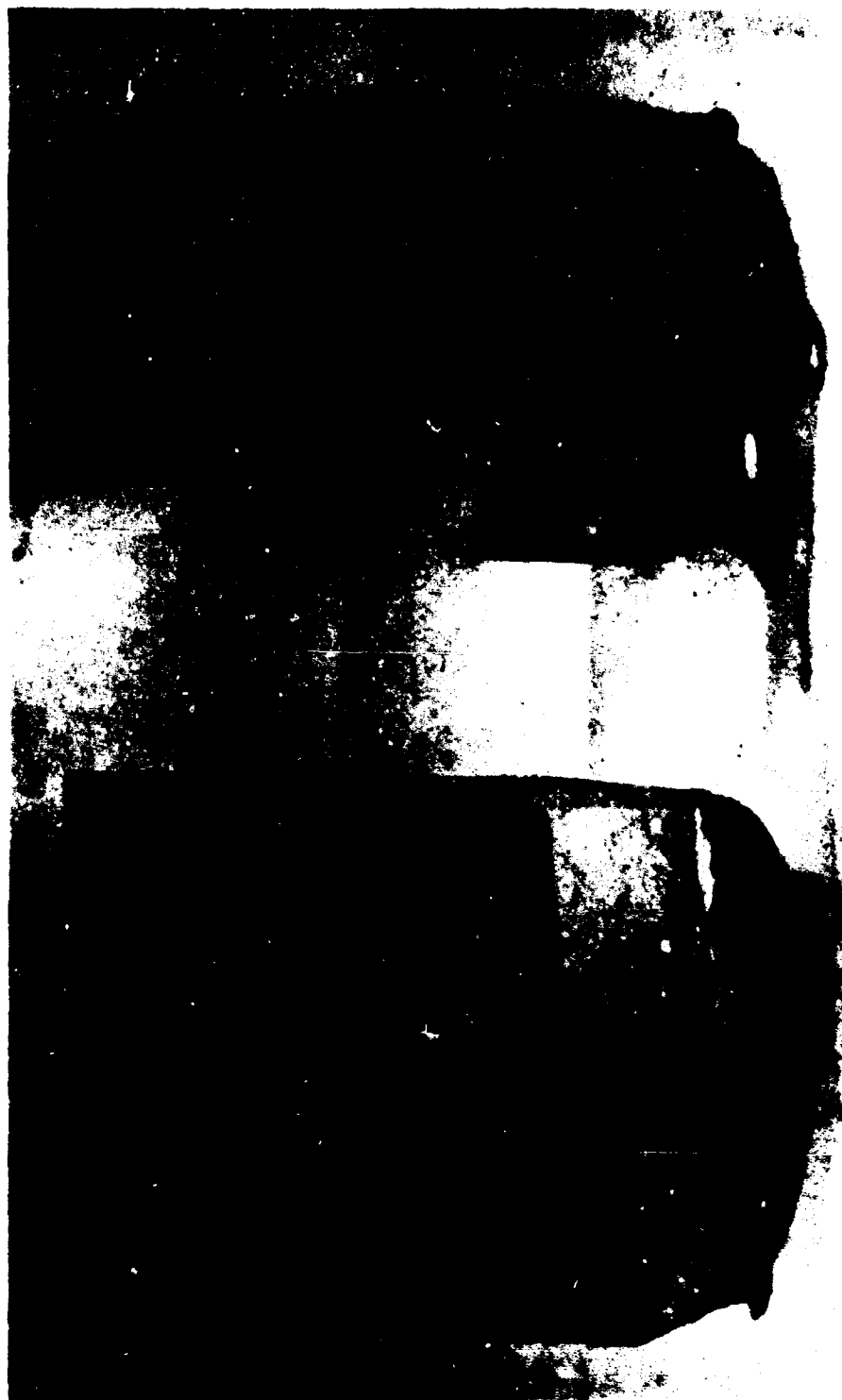


FIGURE 8

CROSS-SECTION PHOTOMICROGRAPHS OF
SERMETEL W COATED COMBUSTION
CHAMBER HOUSING SECTIONS



UNCOATED

FIGURE 9

TEST SPECIMENS AFTER 60 HOUR
EXPOSURE TO SALT FOG

COATED

FUTURE WORK

- 1. Clean full scale components chemically in preparation for coating trials.**
- 2. Prepare a 300 gallon electrophoretic SERMETEL W coating dispersion.**
- 3. Run full scale coating trials.**

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.)		
1. ORIGINATING ACTIVITY (Corporate author) Vitro Laboratories Division Vitro Corporation of America 200 Pleasant Valley Way, West Orange, N. J. 07057		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP --
3. REPORT TITLE Development of Electrophoretic Process for Coating T-53 Air Diffuser, Exhaust Diffuser, and Combustion Chamber Housing with "SERMETEL [®] W"		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) R&D Phase III Technical Report, 7 November 1967 - 21 January 1968		
5. AUTHOR(S) (Last name, first name, initial) Gebler, Kenneth A.		
6. REPORT DATE January 1968	7a. TOTAL NO. OF PAGES 15	7b. NO. OF REFS 0
8a. CONTRACT OR GRANT NO. DAAJ01-67-C-2207(G)	9a. ORIGINATOR'S REPORT NUMBER(S) VL-2488-3-O	
b. PROJECT NO. c. d.	9b. OTHER REPORT NO(S) (Any other numbers that may be associated with this report) --	
10. AVAILABILITY/LIMITATION NOTICES Distribution of this Document is Unlimited		
11. SUPPLEMENTARY NOTES --	12. SPONSORING MILITARY ACTIVITY Directorate Research, Development & Engineering, AVCOM, St. Louis, Mo. 63166	
13. ABSTRACT This report covers activities accomplished during Phase III of a ten (10) month program to develop an electrophoretic coating method for the application of "SERMETEL [®] W" to all critical surfaces of the exhaust diffuser, air diffuser and combustion chamber housing of the T-53 Engine. "SERMETEL W" has been classified by various engine manufacturers and DOD agencies as the best coating available for corrosion protection. During this phase a support fixture for loading, unloading and holding parts during coating was designed, fabricated and installed. A 200 VDC, 50 ampere power supply was checked out in coating experiments on combustion chamber segments and found to be in good working order. Full-scale electrode assemblies were completed for the air and exhaust diffuser components. Satisfactory humidification of coated panels and segments was obtained at 136°F and relative humidities of 61 and 66%. Metallurgical studies of combustion chamber housing segments indicated coatings of good uniformity and salt spray corrosion resistance.		
*Registered Trademark, Product of Teleflex, Inc., North Wales, Pa.		

DD FORM 1473

UNCLASSIFIED
Security Classification

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Electrophoretically Coated Exhaust Diffuser Air Diffuser Combustion Chamber Housing T-53 Engine Corrosion Protection						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system number, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- "Qualified requesters may obtain copies of this report from DDC."
- "Foreign announcement and dissemination of this report by DDC is not authorized."
- "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."
- "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."
- "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.

UNCLASSIFIED

Security Classification